closely allied senses, this rolling causes pleasurable sensations from association with the glorious feasts enjoyed on battle-fields and on putrid carcases of animals," and from this the author hints that possibly, and even probably, when grouse or venison come to our tables in a state of actual decomposition, this represents a taste acquired years ago by the conditions of a primitive life, and is not to be distinguished from a habit which brings upon our domestic dogs the severest reprobation and prompt chastisement. It seems a subject, however unsavoury, well worthy of being investigated, and doubtless many facts bearing on it in reference to uncivilised people are yet to be narrated. Once we call to mind a small knot of semi-civilised Africans captured in a slave dhow off Mosambique that we interrupted at a midnight feast; they were partly eating and partly smelling a mass of half-putrid fish, which seemed, to say the least, to make them uproarious. They had been under civilisation of a sort since their infant days, but seemed full of hereditary instincts. Mr. Nicols's work is full of his own careful observations, and forms a most pleasant addition to our knowledge of the habits and mental faculties of the Carnivora.

Entwickelung der Ortschaften im Thüringerwald. Von Dr. F. Regel. *Petermann's Mitteilungen*, Ergänzungsheft No. 76. (Gotha: Perthes, 1885.)

THIS is a very complete account of the origin and development of the towns and villages in the region known as "the Thuringian Forest," with a special chapter on the geology, topography, and climatology of the district, and a valuable map. The "Thuringian Forest" extends from Eisenach, on the north-west, to Schleusingen, on the south-east, and covers an area of about 1200 kilometres, with a population of 143,986. The mountains of this region are mainly composed of granite, gneiss, palæozoic strata, and porphyry. About a third of the district is still covered with wood. Formerly there was a great variety of trees, comprising the pine, oak, beech, birch, elder, maple, aspen, and willow; but now the forests consist almost entirely of pines, with a few beech woods between Friederichroda and the mediæval walled town of Schmalkalden. The average temperature is somewhat lower than that of the whole of Germany. In the higher villages neither wheat nor the finer kinds of fruit will thrive, and there is frost during from ten to eleven months in the year. The climate, however, is very healthy, and the beauty of the scenery and purity of the mountain streams attract many visitors during the summer months. The highest, and one of the most popular, of these summer resorts is Oberhof, a village at the top of the pass over the Schützenberg, of which the earliest record is in the year 1267. Only oats and potatoes can be grown here (2541 feet above the sea-level), and even the house-sparrow cannot be acclimatised. Eisenach, the capital of the district, is chiefly known on account of the confinement of Luther in the neighbouring castle of Wartburg, which was erected to guard the Thuringian frontier on the west in the years 1067 to 1070. This fortress was close to the junction of two important roads from Erfurt and Mühlhausen, and, as usual in such cases, a town rapidly grew up at the foot of the hill on which the fortress was built. Eisenach now has 13,000 inhabitants, with three churches and several factories. Other towns and villages not so favourably situated owed their development to the neighbourhood of mines, healing waters, &c. Ruhla, a flourishing town of 4500 inhabitants, was celebrated in the first half of the sixteenth century for its steel manufactures, but foreign competition and heavy taxes nearly ruined the place, and in 1748 the population had considerably diminished. The enterprising spirit of the inhabitants, however, was soon drawn into a new channel by the discovery of mineral waters and the introduction of the manufacture of carved amber and pipe-bowls of imitation meerschaum, an industry which has attained considerable proportions. A somewhat similar history is that of the manufacturing town of Ilmenau, which is first mentioned in the chronicles of the fourteenth century. It flourished as an important centre of the copper-mining district of the Ilm up to the year 1739, when the mines were flooded by an inundation. In 1752 the town was burnt to the ground, and, though partly rebuilt, it shared in the general distress caused by the seven years' war, and did not revive until the beginning of the present century, when the manufacture of glass, porcelain, and toys was introduced. In 1838 the establishment of a hydropathic institution afforded a further stimulus to the trade of Ilmenau, and the population has increased from 1972 in 1809 to 4593 in 1880. On these and other places of less note in the Thuringian Forest Dr. Regel's work affords abundant information, though it is somewhat overcharged with notes and references which serve rather to display the extent of the author's reading than to illustrate his text.

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.

[The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.]

River Thames—Abnormal High Tides

REVERTING to my letter of December 19, 1883, inserted in NATURE for January 10, 1884, I append an abstract of salient exceptional tides of last year similar to that accompanying my former letter, from which it will be seen that the maximum elevation of tide is eleven inches less than in 1883, and the excess over the computed rise is also less by seventeen inches than in 1883—in each year resultant on north-north-west gales. Both year's results may be said to be analogous, and each showing how sensitive is the high-water level and how easily it is affected and raised by a change from south and west to northerly winds.

High Waters referred to "Trinity"

1884	Computed	Observed	Difference	Wind
	′ ″	′ ″	′ ″	
Jan. 12 p.m.	0 3 above	1 6 above	1 3	W.N.W.[1]
,, 24 a.m.	3 0 below	0 6 below	2 6	W.N.W.[1]
,, 31 p.m.	0 10 above	2 0 above	1 2	W.S.W.
Feb. 1 ,,	0 10 ,,	2 0 ,,	1 2	W.S.W.
,, 14 ,,	0 8 ,,	2 0 ,,	1 4	W.N.W.[2]
,, 25 ,,	0 10 below	0 3 ,,	1 1	W.N.W.[2]
Mar. 11 ,,	0 2 above	1 9 ,,	1 7	N.[2]
,, 12 ,,	0 6 ,,	2 5 ,,	1 11	W.S.W.[3]
,, 26 ,,	0 2 ,,	1 3 ,,	1 1	E.N.E.
April 22 ,,	2 1 below	0 6 ,,	1 7	E.N.E.[4]
June 7 ,,	1 0 ,,	0 3 ,,	1 3	N.N.E.
,, 25 ,,	1 1 above	2 3 ,,	1 2	N.N.W.
July 8 ,,	0 10 below	0 3 ,,	1 1	S.S.E.
,, 9 ,,	0 6 ,,	0 6 ,,	1 0	S.S.E.
,, 25 ,,	1 0 above	2 0 ,,	1 0	N.N.W.[5]
Aug. 16 a.m.	2 3 below	1 0 below	1 3	S.
,, 25 p.m.	0 3 above	1 4 above	1 1	N.
Sept. 2 ,,	2 7 below	1 6 below	1 1	W.S.W.
,, 5 ,,	"Trinity"	1 6 above	1 6	W.N.W.[6]
,, 22 ,,	0 7 above	1 9 ,,	1 2	W.
Nov. 6 ,,	1 4 ,,	2 9 ,,	1 5	E.N.E.[7]
Dec. 20 ,,	0 5 below	1 9 ,,	2 2	N N.W.[8]
,, 22 ,,	0 9 ,,	0 6 ,,	1 3	N.

J. B. REDMAN

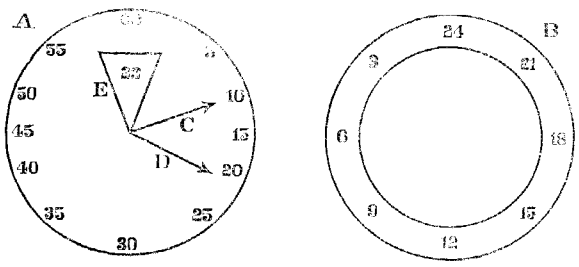
6, Queen Anne's Gate, Westminster, S.W., January 5

Our Future Clocks and Watches

IT is to be hoped that the absurd dial of which you give a drawing will not come into general use. Why not adopt the convenient shape which for more than a century has been in use

[1] Wind Influence. [2] Northerly Influence.
[3] Still felt. [4] Wind blowing right up the estuary.
[5] Sewage up to Westminster with this tide. [6] N.N.W. day before.
[7] Maximum tide of year; W.N.W. gale day before.
[8] Gale and remarkable fall of barometer = 29" 10'.

on the continent for some jewelled watches?:—A is the shape of the visible dial; C is the minute hand; D is the second-hand (sometimes dispensed with); E is an aperture in the dial through which is seen the hour, brought there by the hourly revolution of the wheel B; B is a wheel (and in watches of the size of a



shilling a series of wheels or a metallic band rolling round a drum of special construction for those tiny watches) immediately under the dial, set in motion once every hour, and bringing the corresponding numbers under the aperture E. CHATEL

Jersey, January 5

THE COAL QUESTION

IT is generally admitted that the amount of coal existing below Great Britain at such depths that it can be worked is limited, that large quantities of coal are annually used, and that even the partial exhaustion of the fields, accompanied, as it must be, by a rise in price, would seriously affect almost all our manufactures, and greatly endanger our commercial supremacy. But if we attempt to go further, and say how long our supply of coal will last, we meet with very different estimates. Nearly a hundred years ago the question was discussed by Mr. John Williams, and though the insufficiency of the data did not allow him to give a definite answer, he at least showed the vital importance of the subject.

In 1861, Mr. Hull, by taking into account the area of all our coal-fields and the thickness of the workable seams, calculated that the total available coal in Great Britain was 79,843,000,000 tons; this result was shown by a second calculation to be slightly too low. Further, he assumed that the output of coal, which was then 86,000,000 tons, could not rise much above 100,000,000, and therefore that our supply was sufficient for eight centuries.

Four years later Prof. Stanley Jevons, in an admirable essay on "The Coal Question," accepted the more important of Mr. Hull's data, but showed that they would bear a very different interpretation, and that, instead of the eight centuries spoken of by Mr. Hull, "rather more than a century of our present progress would exhaust our mines to the depth of 4000 feet." He then shows that the absolute physical exhaustion of the fields is improbable, but that before the twentieth century is far advanced the output of coal will probably be checked by a rise in price so considerable that England will be unable to compete in manufactures with other nations still enjoying the profusion of coal to which her present commercial prosperity is so greatly due. These theories and results were reviewed and strengthened by Prof. Marshall in 1878 ("Coal, its History and Uses"), with the aid of more recent statistics; and the present paper is intended to give a short and simple account of the present state of the question from the physical side, with the omission of the more difficult and dubious arguments which may be drawn from Political Economy.

The arguments of Prof. Stanley Jevons were so conclusive, and his results so alarming, that a Royal Commission, of which the Duke of Argyll was chairman, was appointed, in 1866, to investigate the probable quantity of coal contained in the coal-fields of Great Britain. In 1871 the Commission reported that the coal-fields already in use still contained 90,207,000,000 tons of coal, and that concealed coal-fields as yet unopened, near Doncaster, Birmingham, and elsewhere probably contained 56,273,000,000 tons more, or that, in all, 146,480,000,000 tons of coal were available. Since that time about 1,780,000,000 tons of coal have been raised, leaving as the available supply in 1884 about 144,700,000,000 tons. Subsequent investigations show that this estimate is probably considerably too high.

These results were intended to include all beds a foot and upwards in thickness lying within 4000 feet of the surface, though it was rendered probable at the same time that the amount of coal below 4000 feet is not very large. The reason for excluding all beds less than a foot thick is that, at present prices, it is found unprofitable to work them, and hence, except in a few special cases, they are left untouched, though rendered worthless for the future from the disturbance of the strata occasioned by working the other beds.

Though we may assign no limit below which it is impossible to work, the cost of mining increases so rapidly with increased depth that the price of coal must rise very seriously before even the 4000-foot limit can be reached. This increase of cost depends upon various causes. The mere sinking of three shafts like those of Murton, which are said to have cost 300,000*l.*, burdens the undertaking, if it last fifty years, with an interest and sinking fund at 4 per cent. amounting to 13,965*l.* per annum. More powerful winding and pumping engines must be employed, and from the great expense of shaft-sinking, larger areas must be worked from one shaft, necessitating extra expense in underground haulage, ventilation, and supports. Further, each actual coal-hewer requires a larger amount of assistance to secure his safety and to remove his winnings in a deep pit. A coal-hewer working at an open seam on the surface of the ground would only require one labourer to wheel away the coal, while in a deep mine each hewer requires about three men to attend to the removal of the coal, the pumping, and ventilation.

The high temperature of the rock at great depths is also an important factor in the expense of deep mining. In England there is found to be a uniform temperature of 50° F. about 50 feet below the surface; but this temperature is found to increase 1° F. for every 60 feet descended, so that at 4000 feet the temperature of the rock will be about 116° F. And though this temperature is not sufficiently high to prevent working, and might be lowered a few degrees by ventilation, it will cause a considerable increase in the expense, both from the lassitude and extra pay of the men, and the larger amount of air required, which even now at Hetton amounts to 450,000 cubic feet per minute.

These difficulties account for the manifest reluctance to sink deep pits, for the high price charged for the coal from them, and for the fact that the 4000-foot limit has not yet been approached. In 1846 the Messrs. Pemberton's pit at Monkwearmouth reached 1720 feet; in 1858 the Astley pit at Dukinfield reached 2100 feet; in 1869 the Rosebridge pit at Wigan reached 2448 feet; in 1881 the Ashton Moss pit near Manchester reached 2688 feet; and though the Lambert pit in Belgium has been worked at 3490 feet, the circumstances were exceptional, and it is certain that the commercial success of such a pit in England would necessitate a price of coal far higher than it at present is.

The early estimates of the annual output of coal are so unreliable that it is useless to go back further than 1854, when "Mineral Statistics" were first carefully collected by Mr. Robert Hunt, and even in these returns the amounts for the first few years are possibly as much as three per cent. too low, from the difficulties of overcoming the fears of the coal-owners as to the uses which might be made of them. These returns have been collected and arranged by Mr. Meade, in his "Coal and Iron Industries